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Classification and higher-order topology of triple nodal points

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Triple nodal points are degeneracies of energy bands in momentum space at which three Hamiltonian eigenstates coalesce at a single eigenenergy. We present a classification of triple nodal points for spinless particles in all space groups (including magnetic and non-symmorphic ones) based on symmetry properties [2,3]. This provides criteria for the stability of such band nodes and predicts the intricate nodal structures observed in first-principle data obtained for real materials [1]. Based on this classification, we derive a universal higher-order bulk-boundary correspondence, where pairs of triple nodal points are characterized by fractional jumps of the hinge charge [3]. In the presence of space-time-inversion symmetry, this result is enriched by a further correspondence to the Stiefel-Whitney monopole invariant and by additional non-Abelian multiband topology [1]. We demonstrate the bulk-hinge correspondence for the various species of triple nodal points carrying higher-order topology on tight-binding models and using first-principle predictions for real materials.

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